IARD 2008

International Association for Relativistic Dynamics

Διεθνής Ένωση Σχετικιστικής Δυναμικής

6th Biennial Meeting 22-26 June 2008 Thessaloniki Greece

6ο Διεθνές Συμπόσιο 22-26 Ιουνίου 2008 Θεσσαλονίκη Ελλάς

Bringing together researchers from diverse fields whose interests and applications involve Classical and Quantum Relativistic Dynamics

Quark-gluon plasma in heavy ion collisions,
General high energy scattering and particle decay.
Theoretical aspects of general relativity, quantum field theory,
conformal field theories and string theory,
manifestly covariant classical and quantum theories and relativistic dynamics.

Προβλήματα Κλασσικής και Κβαντικής Σχετικιστικής Δυναμικής

Πλάσμα κουάρκ-γλουονίων σε αντιδράσεις βαρέων ιόντων,
Γενική Θεωρία Σκέδασης Υψηλών Ενεργειών και Διασπάσεων.
Γενική Σχετικότητα, Κβαντική Θεωρία Πεδίου,
Σύμμορφες Θεωρίες Πεδίου και Θεωρία Χορδών.
Συναλλοίωτες Κλασσικές και Κβαντικές Θεωρίες και Σχετικιστική Δυναμική.

Organizing Committee / Οργανωτική Επιτροπή

Ioannis Antoniou, Aristotle University, Greece
John Fanchi, Colorado School of Mines, USA
Tepper L. Gill, Howard University, USA
Lawrence P. Horwitz, Bar Ilan University, Israel Tel-Aviv University, Israel
Martin C. Land, Hadassah College, Israel
James A. Lindesay, Howard University, USA
Ronald L. Mallett, University of Connecticut, USA

Under the Auspices and Support of:
Aristotle University of Thessaloniki
Municipality of the Heroic City of Naousa
Euxeinos Club of Naousa

Υπο την Αιγίδα και Στήριξη των:
Αριστοτέλειο Πανεπιστήμιο Θεσσαλονίκης
Δήμος Ηρωικής Πόλης Νάουσας
Εύξεινος Λέσχη Νάουσας

For more information: www.iard-relativity.org/iard2008 , www.math.auth.gr

Image courtesy of CERN

IARD 2008

www.iard-relativity.org/iard2008 , www.math.auth.gr

Conference Venue

Teloglion Foundation of Art,
Aristotle University of Thessaloniki (AUTH)
Ag. Dimitriou 159A , AUTH Campus, Thessaloniki 54636
Tel.: +30.2310.247111, Fax: +30.2310.991610
Web page: www.auth.gr/teloglion

PROGRAM
Monday 23 June

Registration 8:30-9:30

R. Milo 9:30-10:00
On the interpretation of relativity theory

J. Fanchi 10:00-10:40
Tutorial on Manifestly Covariant Quantum Theory in Relativistic Dynamics

Coffee 10:40-11:15

R. Santilli 11:15-12:00
Neutron Synthesis and some comments on Science in Greece

N. Ben-Amotz 12:00-12:30
On the relativistic addition of velocities

Lunch 12:30-14:00

A. Harpaz 14:00-14:35
Two tests for the equivalence principle

P. O'Hara 14:35-15:10
Quantum Mechanics and the Metrics of General Relativity

R.M. Yamaleev 15:10-15:45
The concept of the counterpart of the inertial mass in relativistic mechanics

Coffee 15:45-16:25

H. Mohrbach 16:25-17:00
Berry Phase and Spin Hall Effect

W.W. Zachary 17:00-17:45
Properties of Square Root Operators in Relativistic Quantum Mechanics

Tuesday 24 June

B.H. Lee 9:00-9:40
On the great magnon and spike solutions for strings

Y. Bars 9:40-10:25
Two time physics I

Coffee 10:25-11:10

H. Culetu 11:00-11:40
A time dependent compressible fluid for the black hole interior

G. Kraniotis 11:40-12:15
Motion of a test particle in Kerr spacetime

Lunch 12:15-14:00

N. Ben-Amots 14:00-14:30
Some features and implications of exponential gravity

S. Low 14:30-15:10
Special relativistic quantum mechanics as a projective representation of the inhomogeneous Lorentz group

D.L. Rapaport 15:10-15:50
Torsion geometries, self-reference, multistate logics, time waves and the extended photon

Coffee: 15:50-16:30

C. Acatrinei 16:30-17:10
Canonical quantization of noncommutative field theory

M. Rivas 17:10-17:45
On the kinematics of the center of charge of a spinning charged particle

Wednesday 25 June

Vergina Museum 9:00-13:00 [The Bus leaves from Teloglion, the Conference Venue]

Lunch 13:00-15:00

A.L. Garcoa-Perciante 15:00-15:40
On the physical origin of generic instability in linearized dissipative relativistic hydrodynamics

L.P. Horwitz 15:40-16:20
On the geometry of Hamiltonian orbits in nonrelativistic and
relativistic mechanics, a generalized Lorentz force and the Kaluza-Klein metric.

Coffee 16:20-16:50

I. Antoniou, B. Misra 16:50-17:20
Relativistic Chaos and Internal Time

M. Schiffer 17:20-18:00
A relativistic Schrodinger equation and additional gravitation relativistic fields in Nature.

School of Aristotle 18:00-20:00
Philosophical-Epistemological Discussion

Thursday 26 June

B.L. Hu 9:00-9:45
Quantum Entanglement, Decoherence and Information Flow in
a particle-field system and implications for the black hole information issue

D.S. Lee 9:45-10:30
Stochastic Lorentz force on a point charge moving near a conducting plate

Coffee 10:30-11:10

Y. Bars 11:10-11:55
Two-Time Physics II

Lunch 12:00-14:00 [Business lunch for planning IARD2010]

M. Land 14:00-14:40
On timelike excitations in the relativistic harmonic oscillator

B. Mainland 14:40-15:20
Highly relativistic bound state solutions of the Bethe-Salpeter
equation describing a minimally interacting fermion and scalar

S. Kvinikhidze 15:20-15:55
Gauge invariant currents in the covariant approach to the relativistic 3 body problem

Coffee 15:55-16:40

A. Kryukov 16:40-17:25
Eight theorems on the unification of quantum mechanics and relativity

A. Gersten 17:25-18:00
Non-standard Lagrangians and Actions

End of IARD 2008

ΔΕΛΤΙΟ ΤΥΠΟΥ 18-06-2008
Αριστοτελειο Πανεπιστημιο Θεσσαλονικης
Θεσσαλονικη 54124, www.auth.gr

Για περισσοτερες πληροφοριες:
Καθηγητης Ιωαννης Αντωνιου,
Προεδρος, Τμημα Μαθηματικων ΑΠΘ
Τηλ: 2310997971, 6937222337
Fax: 2310997929
email: iantonio@math.auth.gr
URL: www.math.auth.gr , http://www.iard-relativity.org/iard2008

Το Τμήμα Μαθηματικών του Αριστοτελείου Πανεπιστημίου Θεσσαλονίκης
και η Διεθνής Ενωση Σχετικιστικής Δυναμικής διοργανώνουν το 6ο Διεθνές Συμπόσιο
Κλασσικής και Κβαντικής Σχετικιστικής Δυναμικής στη Θεσσαλονίκη, 23-26 Ιουνίου 2008,
με τη συμμετοχή διαπρεπών επιστημόνων απ' όλο το κόσμο.

Η Σχετικιστική Δυναμική αποτελεί το Μαθηματικό πλαίσιο για την κατανόηση και ερμηνεία της συμπεριφοράς της Υλης σε Μικροσκοπική αλλά και Κοσμολογική κλίμακα. Η διατύπωση της Σχετικότητας από τους Αινσταιν, Πουανκαρέ, Χίλμπερτ στις αρχές του 20ου αιώνα, άνοιξε δύο νέα μεγάλα πεδία έρευνας:
Αφ' ενός την διερεύνηση νέων φαινομένων που λαμβάνουν χώρα σε υψηλές Ενέργειες είτε σε μεγάλη κλιμακα, αφ' ετέρου την ανάπτυξη του αναγκαίου θεωρητικου πλαισίου τοποθέτησης και επίλυσης των προβλημάτων αυτών.

Στο Συμπόσιο θα συζητηθούν επίκαιρα Θέματα Σχετικιστικής Δυναμικής όπως:
- Η περιγραφή Αντιδράσεων και διασπάσεων σωματιδίων σε Υψηλές Ενέργειες και ταχύτητες, όπως αυτές που   χρησιμοποιούνται στους μεγάλους επιταχυντές για να διεισδύσουμε στα μυστικά της Ύλης σε αποστάσεις μικρότερες απο τρισεκατομμυριοστά του εκατοστού.
- Θεωρίες Πεδίων και Χορδών στο Χωρόχρονο, στα πλαίσια των οποίων διερευνώνται συγκεκριμένα προβλήματα Σχετικιστικής Δυναμικής.
- Η Ενοποίηση της μικροσκοπικης Κβαντικής Δυναμικής με την Γεωμετρία του Σύμπαντος, ένα ιδιαίτερα δύσκολο ανοικτό μαθηματικό πρόβλημα που κρατάει κλειστή την πόρτα της γνώσης μας για τις πρώτες στιγμές της ζωής του Σύμπαντος στο οποίο ζούμε.
- Το Πρόβλημα του Χρονου και συναφη Επιστημολογικα και Φιλοσοφικα ζητηματα οπως η Αιτιοτητα και το Ταξιδι στο Χρονο. Για το τελευταιο ο Ροναλντ Μάλετ εχει ηδη δωσει συνεντευξη στον Ελληνικο τυπο [Ταχυδρομος]

Χώρος Εργασιών: Τελλόγλειο Ιδρυμα ΑΠΘ, Αγίου Δημητρίου 159Α, Θεσσαλονίκη, 54636 .
Πρόγραμμα Εργασιών: Δευτέρα 23 Ιουνιου: 09:00-18:00, Τελλόγλειο
Τριτη 24 Ιουνίου: 09:00-18:00, Τελλόγλειο
Τεταρτη 25 Ιουνίου: 09:00-13:00, Βεργίνα
15:00-20:00, Σχολή Αριστοτέλη, Νάουσα
Πέμπτη 26 Ιουνίου: 09:00-18:00, Τελλόγλειο
Βεβαίωση Παρακολούθησης του Συμποσίου χορηγείται στους συμμετέχοντες

Το 6ο Συμπόσιο Σχετικιστικής Δυναμικής τελεί Υπό την Αιγίδα και Στήριξη
του Αριστοτέλειου Πανεπιστημιου Θεσσαλονίκης, του Δήμου της Ηρωικής Πόλης Νάουσας και της Ευξείνου Λέσχης Νάουσας

IARD 2008

ABSTRACTS

Ciprian Acatrinei

Canonical Quantization of Noncommutative Field Theory"

Abstract

Operator methods are used to quantize fields defined on noncommutative spaces, offering an insightful alternative to the usual Wigner-Weyl- Moyal procedure. In particular one can prove easily that the elementary degrees of freedom are bilocal, and live on a reduced configuration space.
The so-called IR-UV mixing is simply interpreted in this framework.
Causality issues become particularly transparent. The procedure is applicable to theories involving noncommutative time as well.

Ioannis Antoniou and Baydyanath Misra

Relativistic Chaos and Internal Time

Abstract

Chaotic Dynamical Systems are distinguished from Integrable ones by the creation of New Information, the are Innovative. The successive innovations form the eigensubspaces of the so-called Internal Time Operator, which is canonically conjugate to the generator of the Time Evolution.
Therefore the Chaotic Relativistic Systems should live in Representations of the Lie Algebra which includes the 10 Generators of the Poincare Group and the Time Operator. This turns out to be an infinite dimensional Lie Algebra, the so-called Relativistic Internal Time Algebra (RIT). The properties and the mathematical characterization of the RIT will be presented. Although the RIT has similar structure to the Bondi-Metzner-Sacks Lie Algebra of Asymptotoc Spacetimes, they are distinct infinite dimensional Lie Algebras.
Some examples and remarks on relativistic invariance of chaos and discreteness of time will be also presented

Netsivi Ben-Amots,

On the Relativistic Addition of Velocities

Abstract

We show that the relativistic addition of perpendicular velocities is NOT Pythagorean, and find the appropriate formula for that addition. We discuss various topics, including relativistic addition of two and three mutual perpendicular velocities in Cartesian and polar coordinates, formulas for transformation of energy and DECOMPOSITION of relativistic velocity to perpendicular components.

Netsivi Ben-Amots,

Some features and implications of exponential gravitation

Abstract:

We discuss some features and implications of exponential gravitation:

1) Comparison between exponential gravitation and general relativity.

2) Gravitational radiation in exponential gravitation theory.

3) A possible exponential gravitation explanation to the origin of jets of Active Galactic Nuclei, quasars and microquasars.

Amos Harpaz
Two tests for the Equivalence Principle

Abstract

Einstein considered the Equivalence Principle (EP) as one of the basic ideas that led him to propose the General Relativity (GTR). However in the physics community, the debates whether EP is indeed a general principle are not settled, and there are still wide discussions about the nature of the principle. We examine the question: “Is the Equivalence Principle a general principle?” by analyzing solutions to two cases:

1. The Twin paradox, and
2. Does a static charge located in a gravitational field radiate?

The solutions to these two cases are given first by using EP, and then by pfysical analysis of the systems involved. The fact that these two methods giveyield the same solutions, may be considered as test cases for the validation of the EP.

Culetu Hristu

A time dependent compressible fluid for the black hole interior

Abstract

A time dependent spacetime for black hole interior of Kantowski - Sachs type is proposed . The Misner -Sharp mass function is proportional with time, as In many self similar cosmological models.
The interior fluid is compressible, anisotropic, with time dependent energy density, pressure and viscosity coefficients. The equation of state is as in many dark energy models. The metric is a solution of Einstein's equations and the source on the r.h.s. obeys all the energy conditions.

Garcia-Perciante A. L. , Garcia-Colin L. S. , Sandoval-Villalbazo A.

On the physical origin of the generic instabilities present in linearized dissipative relativistic hydrodynamics

Abstract

It is shown that the generic instabilities that appear in the framework of relativistic linear irreversible thermodynamics, describing the fluctuations of a simple fluid close to equilibrium, arise due to the inclusion of heat in the energy-momentum tensor that governs the fluid evolution. Further, it is also shown how such instabilities can be avoided within a relativistic linear framework if a Meixner-like approach to the phenomenological equations is employed.

Alexander Gersten

Non-standard relativistic Lagrangians and actions

Abstract

Non-standard and new relativistic Lagrangians and actions are presented and analyzed. Among them are: Lagrangians equivalent to the Hamilton-Jacobi equation, vector and tensor Lagrangians, and actions in phase space. It is known that the Maxwell equations for the electric and magnetic fields can not be derived from a scalar Lagrangian, only the equations for the (gauge invariant) vector potentials can be derived from a scalar one. In the past vector and pseudovector Lagrangians were constructed for the derivation of Maxwell equations and tensor Lagrangians were derived for the Dirac field and all massless fields. The non-standard Lagrangians give rise to conserved currents. A Quantum Lagrangian operator is suggested.

L. Horwitz

On the Geometry of Hamiltonian Orbits in Non-Relativistic and Relativistic Mechanics, a Generalized Lorentz Force and the Kaluza-Klein Metric

Abstract

I review the construction of a translation of Hamiltonian evolution (H) generated by $H = p^2/2M + V(x)$ into an evolution (G) generated by the metric form $H = p^i p^j g_{ij}/ 2M$, with a conformal metric g_{ij} , and how the corresponding geodesic flow can be mapped back to (H). This mapping carries a geometry in which the flow H is imbedded. The geodesic deviation in (H) provides criteria for stability more effective than the usual Lyapunov computation in many examples [Phys. Rev. Lett. 98, 234301 (2007)].

I then discuss the relativistic generalization of this procedure, and show that in the presence of electromagnetic interaction, the Lorentz force in (H) emerges as a geodesic flow in a Kaluza-Klein type metric in (G).

B. L. Hu

Quantum Entanglement, Recoherence and Information Flow in a Particle- Field System and Implications for black hole information issue

Abstract

We study an exactly solvable model where an uniformly accelerated detector is linearly coupled to a massless scalar field initially in the Minkowski vacuum. Using the exact correlation functions obtained earlier we show that as soon as the coupling is switched on one can see information flowing from the detector to the field and propagating with the radiation into null infinity. By expressing the reduced density matrix of the detector in terms of the two-point functions, we calculate the purity function in the detector and study the evolution of quantum entanglement between the detector and the field. Only in the ultraweak coupling regime could some degree of recoherence in the detector appear at late times, but never in full restoration. We explicitly show that under the most general conditions the detector never recovers its quantum coherence and the entanglement between the detector and the field remains large at late times. To the extent this model can be used as an analog to the system of a black hole interacting with a quantum field, our result seems to suggest in the prevalent non-Markovian regime, assuming unitarity for the combined system, that black hole information is not lost but transferred to the quantum field degrees of freedom. Our combined system will evolve into a highly entangled state between a remnant of large area (in Bekenstein's black hole atom analog) without any information of its initial state, and the quantum field, now imbued with complex information content not-so-easily retrievable by a local observer

Georgios V. Kraniotis

Motion of a test particle in Kerr spacetime

Abstract

The equations of general relativity in the form of timelike and null geodesics that describe motion of test particles and photons in Kerr spacetime are solved exactly including the contribution from the cosmological constant.
Our closed form solutions are applied to the following situations:
1) calculation of frame-dragging (Lense-Thirring effect) and periapsis advance for the orbits of S-stars in the central arcsecond of our Galaxy assuming that the galactic centre is a rotating (Kerr) black hole.
In addition we apply our solutions for the calculation of frame-dragging and periapsis advance for stellar orbits in regions of strong gravitational field close to the event horizon of the galactic black hole, e.g. for orbits in the central milliarcsecond of our Galaxy.
Such orbits are the target of the GRAVITY experiment.
2) Bending of light from the gravitational field of the galactic centre black hole for various values of the Kerr parameter and the impact factor.

A. Kryukov

Eight theorems on the unification of quantum mechanics and relativity

A mathematical framework that unifies the standard formalisms of special relativity and quantum mechanics is proposed. For this a Hilbert space H of functions of four variables (x,t) furnished with an additional indefinite inner product invariant under Poincare transformations is introduced.
For a class of functions in H that are well localized in the time variable the usual formalism of nonrelativistic quantum mechanics is derived. In particular, the interference in time for these functions is suppressed; a motion in H becomes the usual Shroedinger evolution with t as a parameter.
The relativistic invariance of the construction is proved. The usual theory of relativity on Minkowski space-time is shown to be “isometrically and equivariantly embedded” into H. That is, the classical space time is isometrically embedded into H, Poincare transformations have unique extensions to isomorphisms of H and the embedding commutes with Poincare transformations. The relationship to the Stueckelberg theory and its development is discussed and some open problems are mentioned.

S. Kvinikhidze

Gauge invariant currents in the covariant approach to the relativistic three body problem

Abstract
We present a general method for incorporating an external electromagnetic field and generalized parton distributions (GPDs) into descriptions of few-body systems whose strong interactions are described by integral equations. In particular, we address the case where the integral equations are those of quantum field theory and effectively sum up an infinite number of Feynman diagrams. The method involves the idea of gauging the integral equations themselves, and results in electromagnetic amplitudes where an external photon is effectively coupled to every part of every strong interaction diagram in the model. Current conservation is therefore implemented in the way prescribed by quantum field theory. We apply our gauging procedure to the four-and three-dimensional integral equations describing a system of three relativistic particles. In this way we obtain the expressions needed to calculate all possible electromagnetic processes of the three-body system. An interesting aspect of our results is the natural appearance of a subtraction term needed to avoid the overcounting of diagrams. We show how GPDs can be determined in the case where hadrons are described in terms of their partonic degrees of freedom through solutions of dynamical equations. Within the model of strong interactions defined by the dynamical equations, all possible mechanisms contributing to the GPDs are taken into account, and all GPD sum rules are satisfied automatically. The formulation is general and can be applied to determine generalized quark distributions, generalized gluon distributions, transition GPDs, nucleon distributions in nuclei, etc.

Martin Land
On Timelike Excitations in the Relativistic Harmonic Oscillator

We show that the covariant quantum harmonic oscillator in 2+1 dimensions, unlike its 3-dimensional nonrelativistic analog, admits a reasonable solution in polar coordinates that is essentially inequivalent to the problematic solution found by assuming separability in space and time. In the nonrelativistic case, Dirac's Hamiltonian factorization is readily generalized from one pair of creation/annihilation operators to three separable dimensions in space. By expressing the O(3) generators in terms of the creation/annihilation operators, we construct unitary combinations of the mode number states that form eigenstates of energy, total angular momentum, and one angular momentum component, and so reproduce the features of explicit solutions to the

Schrodinger equation in polar coordinates. For the covariant case, we apply the method of Horwitz and Arshansky to solve the Schrodinger equation with a spacelike coordinate parameterization, leading to a positive-definite spectrum and a ground state energy corresponding to two degrees of freedom. Generalizing the nonrelativistic case, we express the O(2,1) generators through the creation/annihilation operators, and construct unitary combinations of the mode number states that form eigenstates of energy and angular momentum. However, these eigenstates are unitarily inequivalent to the Horwitz-Arshansky solutions, and suffer the well-known defects associated with space and time separability in Minkowski coordinates: unbounded negative-energy timelike excitations and too many degrees of freedom in the energy of the zero-excitation state. These results suggest that the difficulties normally associated with the covariant harmonic oscillator may actually be a problem of interpretation when generalizing the Cartesian separability of the nonrelativistic oscillator to spacetime separability in the relativistic case.

Bum-Hoon Lee

On the giant magnon and spike solutions for strings

Abstract

The remarkable string theory-gauge theory duality relates the Gravity description on AdS with that of the conformal field theory in the boundary spacetime.
Related to the spectrum matching in both sides, we introduce some examples of the string excitation solutions.
We show the dispersion relation among various charges and give physical interpretation of these solutions.

Da-Shin Lee

Stochastic Lorentz forces on a point charge moving near the conducting plate

Abstract

The influence of quantized electromagnetic fields on a nonrelativistic charged particle moving near a conducting plate will be discussed. We give a field-theoretic derivation of the nonlinear, non-Markovian Langevin equation of the particle by the method of Feynman-Vernon influence functional. This stochastic approach incorporates not only the stochastic noise manifested from electromagnetic vacuum fluctuations, but also dissipation backreaction on a charge in the form of the retarded Lorentz forces. The observational consequences will be discussed.

Stephen Low

Special relativistic quantum mechanics as a projective representation of the inhomogeneous Lorentz group

The Lorentz group defines the transformation of position, time as well as the energy momentum frames of states that are inertially related. Special relativistic quantum mechanics may be understood as the projective representations of the inhomogeneous Lorentz group. Special relativity does not state how the frames of noninertial frames are related. If the noninertial system is due to gravity, general relativity resolves this through a curved manifold where particles under the action of gravity follow geodesics that are locally inertial trajectories. However, general relativity does not address the issue of how the frames of noninertial particles on a flat space due to a force other than gravity are related. We study this starting with a quantum system with physical observables of position, time, energy and momentum that are the Hermitian representation of the generators of the algebra of the Weyl-Heisenberg group. We assume this is true for any states related by the projective representation of the relativity group. We show that this results in a consistency condition that requires the relativity group to be a subgroup of the group of automorphisms of the Weyl-Heisenberg algebra and consider the relativity groups that in addition leaves invariant an orthogonal line element. We study this for the Newtonian time and Minkowski proper time line elements to show this defines noninertial transformation groups that are expected. Finally, we study the Born-Green metric that results in a generalization to reciprocal relativity where the rate of change of momentum are bounded in addition to velocity. A quantum mechanics can be derived using the same method as above for SRQM that has the expected limiting behavior.

Bruce Mainland

Highly-Relativistic, Bound-State Solutions of the Bethe-Salpeter Equation Describing a Minimally Interacting Fermion and Scalar

Abstract:
To explore the possibility that some ``elementary particles'' might be highly-relativistic bound states, numerical solutions are obtained in the ladder approximation to the Bethe-Salpeter equation describing a spin-1/2 fermion and a spin-0 boson with arbitrary masses that are bound by quantum electrodynamics. The feature that makes numerical solutions difficult to obtain is present, both when the mass of the bound state is zero and the Bethe-Salpeter equation is separable, and when the mass of the bound state is nonzero and the equation is apparently non-separable: it does not appear to be possible to discretize the Bethe-Salpeter equation in such a way that the coupling constant, which is real in the Lagrangian, is

also always real when calculated as an eigenvalue of the discretized Bethe-Salpeter equation. Nevertheless, solutions with real coupling constants are obtained using a systematic, numerical method that yields solutions to many, if not all, two-body, bound-state Bethe-Salpeter equations. As part of the process of obtaining solutions, boundary conditions satisfied by the solutions are determined analytically. At large momenta such boundary conditions are often determined only within ranges. Because the calculated value of the coupling constant is sensitive to the behavior of the solution at large momenta, an iterative procedure is used to ensure that the input boundary conditions and the boundary conditions actually obeyed by each solution agree.

Rafi Milo

On the interpretation of Special Relativity Theory

Abstract

The Newtonian perception of space and time ruled our physical reality for two hundred and fifty years. According to Issac Newton, time is absolute and identical in all inertial (and non -inertial systems) and therefore simultaneity of events is absolute as well. In the Newtonian world there is no “twin effect”, by which a high speed moving person will be younger than his twin brother when they meet again. In any case, there is no “twin paradox”, whatsoever.
The Special Relativity Theory (SRT) was supposed to revolutionize those concepts. According to its standard interpretation, simultaneity of events is no longer absolute, but relative, depending on the inertial frame of reference. Moreover, twins in relative motion will age differently.
The “relativity of simultaneity” concept caused a dramatic impact on the perception of our physical reality. Space-time turns to be a static entity which already includes all events. Thus, the division of events into past, present and future is not physically real any more, but “persistent illusion”, as indicated by Albert Einstein. Moreover, the “twin paradox” or actually the “twin effect” caused people to believe in the possibility of “time travel” to the future as long as you could move fast enough, close to the speed of light.
The aim of this paper is to throw out the “ghosts”, which entered physics through the backdoor of Special Relativity. We will show that “absolute simultaneity” is fully compatible with special relativity basic assumptions, as well as with the Lorentz transformation. Thus, the division of events into past, present and future is not a “persistent illusion” at all, but actual physical reality. In addition to that, we will prove that “time travel”, based on the “time dilation” effect of SRT is not physically real, but a “wishful thinking”.

As we will show, nothing is wrong with special relativity theory, but something very crucial is wrong with its current standard interpretation of space-time effects…

Hervé Mohrbach

Berry phase and spin Hall effect

Abstract:
It has been recently found that the equations of motion of several semiclassical systems must take into account anomalous velocity terms arising from Berry phase contributions. Those terms are for instance responsible for the spin Hall effect in semiconductors or the gravitational birefringence of photons propagating in a static gravitational field. Intensive ongoing research on this subject seems to indicate that actually a broad class of quantum systems might have their dynamics affected by Berry phase terms. In this talk we will review the implication of a new diagonalization method for generic matrix valued Hamiltonians based on a formal expansion in power of h-bar which leads to a diagonal energy operator and dynamical operators which depend on Berry phase terms. Focusing on the semiclassical approximation, we will see that a large class of quantum systems, ranging from relativistic Dirac particles in strong external fields to Bloch electrons in solids as well as electron in graphene have their dynamics radically modified by Berry terms.

Quantum Mechanics and the Metrics of General Relativity — Part 2

Paul O'Hara

Dept. of Mathematics
Northeastern Illinois University
5500 North St. Louis Avenue
Chicago, IL 60625-4699, USA.

email: pohara@neiu.edu

1 Abstract

In a previous work I established a one-to-one correspondence between linearized space-time metrics of general relativity and the wave equations of quantum mechanics for particles moving on geodesics in a pseudo-Riemannian space. I did this by showing that the quantum-mechanical wave equations can be derived as the dual of the Dirac "square-root" of the metric. In other words, if

$$ds^2 = g_{\mu\nu} dx^\mu dx^\nu = \eta_{ab} dx^a dx^b \tag{1}$$

where a and b refer to local tetrad coordinates and η to a rigid Minkowski metric of signature -2, then associated with this metric and the vector **ds** is the scalar ds and a matrix $\tilde{ds} \equiv \gamma_a dx^a$ respectively, where $\{\gamma_a, \gamma_b\} = 2\eta_{ab}$, with γ_a transforming as a covariant vector under coordinate transformations.

Moreover, since ds is an invariant scalar, and $\tilde{ds}^2 = ds^2$ we identified the "eigenvalue" ds with the linear operator $\tilde{ds}$ by forming the spinor eigenvector equation $\tilde{ds}\xi = ds\xi$. This is equivalent to associating the metric

$$ds^2 = g_{\mu\nu} dx^\mu dx^\nu = \eta_{ab} dx^a dx^b \tag{2}$$

with the spinor equation:

$$ds\xi = \gamma_a dx^a \xi. \tag{3}$$

Corresponding to each tangent vector $\frac{\partial}{\partial x^a}$, there exists a dual one-form dx^a. In a similar way, the $\tilde{ds}$ matrix above can be seen as the dual of the expression $\tilde{\partial}_s \equiv \gamma^a \frac{\partial}{\partial x^a}$, where γ^a is defined by the relationship $\{\gamma^a, \gamma_b\} = 2\delta^a_b$ and the dual map defined by

$$\left\langle \tilde{ds}, \tilde{\partial}_s \right\rangle \equiv \frac{1}{\mathrm{Tr}(dx^i \partial_j)} \gamma_a \gamma^b dx^a \frac{\partial}{\partial x^b} \equiv \frac{1}{\delta^i_i} \gamma_a \gamma^b \frac{\partial x^a}{\partial x^b} = 1 \tag{4}$$

remains invariant.

Putting these two results together allowed us to consider equation (3) as the dual of the equation:

$$\frac{\partial \psi}{\partial s} = \gamma^a \frac{\partial \psi}{\partial x^a}, \tag{5}$$

where $\frac{\partial}{\partial s}$ refers to differentiation along a curve parametrized by s. We referred to (5) as a (generalized) Dirac equation and justified this terminology by showing that it was equivalent to the motion of a particle moving on a geodesic, and to the first approximation could be used to derive the usual form of the Dirac equation.

However, there is a problem. As long as the particle is moving on a geodesic the product of the two spinor equations becomes

$$\tilde{ds}\tilde{\partial}_s \psi = ds \frac{\partial \psi}{ds} \tag{6}$$

and so one feels justified in identifying $\tilde{ds}$ with its eigenvalue ds, in that the eigenvalues serve to pick out the equilibrium states of the system. Similarly we can identify $\tilde{\partial}_s \psi$ with its scalar state $\frac{\partial \psi}{\partial s}$. But, when particles are no longer in free fall (moving on geodesics) then such an identification is not-valid, because of the dynamics of the situation. In particular

$$\begin{aligned} 2\tilde{ds}\tilde{\partial}_s &= \left[\tilde{ds}, \tilde{\partial}_s\right] + \left\{\tilde{ds}, \tilde{\partial}_s\right\} && (7) \\ &= \left[\tilde{ds}, \tilde{\partial}_s\right] + 2ds\frac{\partial \psi}{ds}, && (8) \end{aligned}$$

making things more complicated. In this presentation, I will attempt to resolve this difficulty by modifying the Dirac equation by incorporating an additional term into equation (5) and show that this additional term has the characteristics of entropy.

Diego L. Rapoport

Torsion Geometries, Self-reference, Multistate logics, Time Waves and the Extended Photon.

Abstract:

We review the introduction of torsion geometries in terms of a non-trivial self-referential definition of geometries in terms of distinctions (dislocations). We abstract this distinction to the concept of a general distinction on a plane, with two axioms which correspond to the Laws of Form of logician George Spencer-Brown, which can be interpreted in terms of the cohomology of differential forms and invariance of the canonical connection by translations on the plane. We stretch this distinction on the plane to yield a Klein-bottle, as the topology for the self-referential process of time-space self-production as the reentrance of the distinguished plane into itself. The topology of the Klein-bottle is associated to spin through the kinematics of the hypercomplex numbers due to Charles Musηs; the depth variable of this bottle is associated with time, following the phenomenological analysis (in the sense of philosophers M. Merleau-Ponty and M. Heidegger) due to Steven M. Rosen in The Self-Evolving Cosmos, A Phenomenological Approach to Nature's Unity-in-Diversity (Series Knots and Everything, World Scientific, 2008).
This algebra due to Spencer-Brown with two elements, the void and the distinction, yields on the plane a Boolean logic, while the solution of the paradoxical second-order equations yields oscillating time waves in reentering and outgoing the distinguished plane in the additional depth dimensions, and further yield a four-state non-Boolean algebra, where the two additional elements are related to time, in agreement with the Klein-bottle topology. We argue that this construction is related to the proposal of the photon as an extended entity (which fuses spacetime-object-subject) in Rosen's phenomenological analysis, while a phenomenological (Hegelian) approach to multistate logics is related to the introduction of time into logic and a subject non-trivially identified with the object viz. a viz. the trivial identification of object and subject in the context of Aristotelian-Boolean logic. We discuss the relations between the latter logic and the notion of a point-particle, in contrast with multistate logics which are naturally associated with non-pointlike particles such as in Hadronic Mechanics, due to R.M. Santilli.
We present a Cartan-topology model of the photon as an extended singularity, firstly in terms of the electromagnetic potential term in the de Rham decomposition of the trace-torsion of a connection on four-dimensional time-space, and secondly, in terms of the hypercomplex solutions of the system given by the wave and the eikonal equations.

Martin Rivas

On the kinematics of the center of mass of a spinning particle

Abstract

In particle physics, most of the classical models consider that the center of mass and center of charge of an elementary particle, are the same point. This presumes some particular relationship between the charge and mass distribution, a feature which cannot be checked experimentally. In this contribution we give three different kinds of arguments suggesting that, if assumed different points, the center of charge of an elementary spinning particle moves in a helical motion at the speed of light, and it thus satisfies, in general, a fourth order differential equation. If assumed a kind of rigid body structure, it is sufficient the description of the center of charge to know also the evolution of the center of mass and the rotation of the body. This assumption of a separation betwen the center of mass and center of charge gives a classical contribution to the spin of the system and also justifies the existence of a magnetic moment produced by the relative motion of the center of charge. This corresponds to an improved model of a charged elementary particle, than the point particle case. This means that a Lagrangian formalism for describing charged elementary spinning particles has to depend, at least, up to the acceleration of the position of the charge, to properly obtain fourth order dynamical equations. This result is compared with the description of a classical Dirac particle obtained from a general Lagrangian formalism for describing spinning particles.

Ruggero Maria Santilli

On the laboratory synthesis of neutrons from protons and electrons

Abstract

We report measurements, necessarily preliminary due to their novelty, toward the laboratory synthesis of the neutron from protons and electrons, in the hope that said measurements are not judged via theoretical conjectures, but subjected instead to independent re-runs for their verification or denial, said process being requested by possible new clean energies so much needed by our increasing environmental problems.
pacs 28.20.Fc; 29.25.Dz; 24.10.-i

M. Schiffer

The Schroedinger equation and Additional Gravitation Relativistic fields in Nature

Abstract

In this talk we present a new framework to describe the Relativistic Dynamics of particles and of the geometry itself. It is based upon a relativistic

Schroedinger equation which contains a gauge like vector field and a scalar potential, in addition to the wave-function. We show that the scalar field can be mapped into the conformal factor of Relativistic Mond Theory proposed by Bekenstein and Sanders. This is quite promising, as it might be the key to the solution to the dark matter problem in the Universe.

Robert M.Yamaleev

The concept of counterpart of the inertial mass in the relativistic mechanics.

Abstract

In this contribution we present a new characteristic parameter of the relativistic particle which is interpreted as a counterpart of the inertial mass, we call "light-mass". This concept is based on a new representation for energy-momentum regular near the zero-mass point. The theory allows to explain the nature of mass of the "left"-neutrino and violation of the parity from first principles of the relativistic dynamics. The group of transformation complement to the Lorentz-group is defined. Hypothesis on quantization of the energy-momentum of the particle near the light velocity is found.
An analogue between the present theory and the statistical thermodynamics is outlined.

W. W. Zachary and T. L. Gill

Properties of the Square Root Operator in Relativistic Quantum mechanics

Abstract

In this talk I will discuss recent work on an analytical representation for the standard square root operator of relativistic quantum theory. Of particular interest is the fact that, from a physical point of view, this representation provides two explicit nonlocal integral operators.

The first is short-range (e.g., it has a natural cutoff analogous to that of the Yukawa potential), while the second is long-range and is analogous to the Coulomb potential.